limited and the requirement for a suitable landing area is critical. An effort to combine the requirements for capacity, speed and basing, has lead to some studies of unconventional aircraft designs. One design concept that has been considered utilizes a large rectangular wing surface with large bodies attached to each wing tip. The use of the two large bodies results in essentially doubling the capacity of a conventional single-body aircraft with no increase in length. The large area of the wing provides adequate lift to sustain normal flight with heavy loads. The bodies could also be shaped to provide for water-based operation With the wing positioned high on the bodies a cushion of air would be provided that would permit operation as a wing-in-ground (WIG) effect vehicle. With judicious positioning of trailing-edge wing flaps and vectoring jet nozzles, vertical take-off and landing (VTOL) capability could be achieved. In addition, the bodies could be designed to contain some helium for buoyant lift with additional kinetic lift provided by the wing. Thus, the inboard wing, twin-body arrangement potentially provides for large load carrying capability with a vehicle that could operate in free-air as an airplane, or near the surface in a WIG mode. Such a design would also have greater basing freedom in a VTOL mode or as a hybrid airship.

Agriculture, Forestry and Aquaculture Science

THE EFFECTS OF SHEEP ON NITROGEN CONCENTRATIONS IN SOIL. Sarah J, Casey, Dept. of Biol., Ferrum College, Ferrum, VA 24088 & Brian D. Whitaker, Dept. of Agriculture, Ferrum College, Ferrum, VA 24088. Ruminants are an important part of agriculture because they add value to the existing ecosystem. This study was conducted to evaluate the effects of grazing sheep on agroforestry pasture on the nitrogen content of the soil. Sheep were placed on a traditional grazing pasture or an agroforestry pasture (with trees). Soil samples were collected at 0, 30, and 60 d during the study and analyzed for total nitrogen content at the end of the study. The amount of nitrogen in the soil from the forest without sheep was significantly greater ($P < 0.05$) compared to the other plots. These results indicate that producing sheep on agroforestry based pasture may increase the quality of the soil by increasing the nitrogen content over time.

NODULATION TRAITS OF TEPARY BEAN INOCULATED WITH 15 BRADYRHIZOBIAL STRAINS. Michele Mohrmann & Harbans L. Bhardwaj, Agricultural Research Station, PO Box 9061, Virginia State University, Petersburg VA 23806. In order to develop tepary bean (*Phaseolus acutifolius* A. Gray), a highly drought-tolerant summer crop, as a summer legume cover crop to meet N needs of succeeding winter cereals, we studied nodulation following seed treatment of three tepary bean lines (Black, Tan, and White-seeded) with 15 bradyrhizobial strains. In this replicated greenhouse study, we nodule number, and nodule size from approximately 40-day old plants. Nodule numbers were recorded on a scale of 1 (less than five nodules per plant) to 3 (greater than 20 nodules per plant) whereas nodule size was recorded on a scale of 1 (nodules small and similar to mustard/canola seed in size) to 3 (nodules large and similar to soybean seed in size). We also recorded chlorophyll readings with Minolta SPAD-502 meter. Significant differences were observed among

15 bradyrhizobial strains for all traits under study. Differences among three tepary bean lines were not significant. Results indicated that UMR-3007, UMR-3043, and USDA-3254 strains were the most efficient nodulators of tepary bean. Significant and positive correlations exited between SPAD readings and nodule number score (0.70**) and nodule size score (0.43**).

THE ANORECTIC EFFECT OF NEUROPEPTIDE AF IS ASSOCIATED WITH SATIETY-RELATED HYPOTHALAMIC NUCLEI. B.A. Newmyer, M.A. Cline & M. Smith, Radford University, Department of Biology, Radford VA 24142. Neuropeptide AF (NPAF), a member of the RFamide family, is encoded by the same gene as neuropeptide FF (NPFF) which causes short-term anorexia. However, reports on the role of NPAF on appetite-related process are lacking. Thus, intracerebroventricular (i.c.v.) injections of 4.0, 8.0 and 16.0 nmol NPAF were administered to chicks in order to observe its effect on food and water intake. Chicks treated with 8.0 and 16.0 nmol i.c.v. NPAF decreased both their food and water intake. Additionally, all doses of NPAF injected caused a similar reduction in whole blood glucose concentration 180 min after injection. In a second experiment, chicks that received i.c.v. NPAF had increased number of c-Fos immunoreactive cells in the dorsomedial, paraventricular (magnocellular and parvicellular parts) and ventromedial nuclei. The arcuate nucleus and lateral hypothalamic area were not affected. In a third experiment, NPAF-treated chicks exhibited fewer feeding pecks and spent less time perching, while increasing time spent in deep rest. Other behaviours including exploratory pecking, escape attempts, defecations, distance moved, and time spent standing, sitting and preening were not affected by NPAF injection. We conclude that NPAF causes anorectic effects that are associated with the hypothalamus.

CALCITONIN GENE-RELATED PEPTIDE IS ASSOCIATED WITH ANOREXIGENIC EFFECTS IN CHICKS (*Gallus gallus*). Wendy A. Calchary & Mark A. Cline, Department of Biology, Radford University, Radford VA 24142. Calcitonin gene-related peptide (CGRP) is released from the gastrointestinal tract following ingestion and causes satiety in mammals. Its effects on appetite in non-mammalian vertebrates are unreported. In Experiment 1, fasted chicks reduced food and water intake after central injection of CGRP. In Experiment 2, central CGRP caused increased c-Fos immunoreactivity in the arcuate (ARC) nucleus, paraventricular nucleus (PVN), periventricular (PHN) and ventromedial (VMH) hypothalamic nuclei. The results of Experiment 3 demonstrate that intraperitoneal injection of CGRP also causes reduced food and water intake. c-Fos immunoreactivity was increased in the ARC, PHN, PVN and VMH in Experiment 4 after intraperitoneal injection of CGRP. In chicks and mammals stimulation of opioid receptors stimulates feeding. Interestingly, increased CGRP concentration coincides with decrease morphine function in the rodent central nervous system. In Experiment 5, co-injection of CGRP and beta-funaltrexamine did not suppress food intake more than CGRP and beta-funaltrexamine when injected alone. In Experiment 6 co-injection of CGRP and ICI-174,864 caused a greater reduction in food intake than CGRP and ICI-174,864 when injected alone. In Experiment 7, co-injection of CGRP and nor-binaltorphimine caused a greater reduction in food intake than CGRP and nor-binaltorphimine when injected

alone. In Experiment 8, CGRP did not reverse hyperphagia induced by NPY. In Experiment 9, hyperphagia induced by B-endorphin was reversed by CGRP. In conclusion, the mechanisms of CGRP induced satiety have some similarities and differences between avian and rodent models. The results presented here provide new insight into the evolution of vertebrate satiety regulatory mechanisms.

BIOLOGICAL NITROGEN FIXATION IN WHITE LUPIN. Harbans L. Bhardwaj, Agricultural Research Station, PO Box 9061, Virginia State University, Petersburg VA 23806. White lupin (*Lupinus albus* L.), one of five cultivated species of *Lupinus* genus, has tremendous potential as a grain and a green manuring crop. During 1940s, it was used to supply N to succeeding cotton crop in the southern USA sometimes called "The Lupin Belt". Availability of cheap fertilizers, lack of cold-tolerance, and agricultural policies resulted in lupin's demise so that by 1960s it has almost disappeared. Recently, there has been a renewed interest in using lupin as legume cover crop to meet N needs of succeeding crops. Lupin seed and plant tissue are characterized by low alkaloids ("Sweet") or high alkaloid ("Bitter"). It is desirable to have lupin lines with sweet seeds and bitter plant tissue since bitter plant tissue can act as a natural pesticide for disease and insect pests upon incorporation into the soil. We conducted biological N Fixation (BNF) studies with lupin lines varying in their alkaloid contents. The results indicated that high-alkaloid (Bitter) lupin lines had greater nodulation, a measure of biological N fixation, as compared with low-alkaloid (Sweet) lines. However, enough variation existed among the 97 germplasm lines to indicate that it may be possible to develop lupin lines with sweet seed and bitter plant tissue.

POST-HARVEST EXTENSION OF MARKET SEASON FOR POND-RAISED LIVE FRESHWATER SHRIMP IN GREENHOUSE TANKS. Brian L. Nerrie, Virginia Cooperative Extension, PO Box 9081, Virginia State University, Petersburg VA 23806. Freshwater shrimp (*Macrobrachium rosenbergii*) are fast-growing tropical organisms that are increasingly farmed in Virginia, especially in the tobacco growing counties. They are stocked as juveniles (~0.2 g) in late May-early June and harvested in late September-early October (>35 g). More than 80% of the freshwater shrimp harvested in Virginia are sold fresh on-ice to buyers on harvest day ($16.00-25.00/kg) with some frozen for future sales. *M. rosenbergii* cannot survive water temperatures below 14°C. A demand exists for off-season live fresh shrimp. Shrimp harvested from ponds at VSU's Randolph Farm during the first week of October 2007 were either frozen (-10 °C) or transferred to aerated 1000 liter circular tanks. Tanks were equipped with substrate (orange-plastic fencing) and stocked at a low density of 25 shrimp per tank. Water temperature was maintained between 15-20 °C by aquaria heaters to reduce the need for feeding, and therefore minimize growth, molting and cannibalism. Shrimp were harvested after 150 days on 20 March and a taste test conducted to compare with previously frozen whole shrimp. A taste panel reported high acceptance and no differences ($P>0.05$) in taste, texture, and appearance between the previously frozen shrimp and fresh inventoried shrimp. Shrimp mortalities (>50%) were observed associated with high tank water temperature resulting from outside temperatures exceeding 30°C.

SURVIVAL AND GROWTH COMPARISONS OF CATFISH (*ICTALURUS PUNCTATUS*) FINGERLINGS IN CAGES OVER WINTER, SECOND-YEAR TRIAL WITH INDUSTRY APPLICATION. Scott H. Newton & Edward N. Sismour, Agriculture Research Station, PO Box 9061, Virginia State University, Petersburg VA 23806. Channel catfish (*Ictalurus punctatus*), an important fishery resource in Virginia, are regularly imported from southern states because of high demand. Previous results suggested that purchasing fingerlings in the fall and holding them over winter might be an effective management strategy to increase productivity and reduce mortality associated with transport and stocking in the spring. We conducted a second-year trial from November 2008 to April 2009 at VSU and at Gold Hill farm (GHF) in Buckingham County. Two groups of catfish purchased in 2008, one in April (spring) and the other in mid-October (fall), were compared. Fingerlings were restocked in mid-November at both locations into separate sets of three cages with 250 fish per cage. Total lengths and weights were measured on subsamples of 60 fish per cage at both stocking and harvest. Fish were fed a standard, floating-pellet ration when winter pond water temperature exceeded 10 °C. Catfish fingerlings in 2007-08 increased in weight by 17% for the spring group and 25% for the fall group, and both groups had high (>99%) survival. No increase in length or weight was observed in 2008-09 and survival was much lower, about 60% at both VSU and GHF for the spring catfish and about 30% and 70%, respectively, at VSU and GHF for the fall catfish. Fingerlings at VSU were affected by an out break of White Spot disease (Ich). Persistent, low (<10 °C) water temperature over the 2008-09 winter limited feeding opportunities resulting in poor growth and survival performance.

SURVIVAL AND GROWTH OF CHANNEL CATFISH (*Ictalurus punctatus*) FINGERLINGS IN CAGES WITH LONG-TERM ORAL ADMINISTRATION OF B-GLUCAN, AN INITIAL ASSESSMENT. Edward N. Sismour & Scott H. Newton, Agriculture Research Station, PO Box 9061, Virginia State University, Petersburg VA 23806. Bacterial disease is a major cause of financial loss to aquaculture producers. Antibiotics are typically used to control disease; however, only a small number are approved for food fish and legal restrictions limit usage. Immune system enhancement is an alternative approach with demonstrated benefits in numerous agricultural applications. β-1,3/1,6-Glucans are an integral part of the cell wall in bacteria, fungi, and some plants. The structural pattern is highly conserved and binding of these molecules to pattern recognition receptors in macrophage cell membranes upregulates nonspecific immune responses of these cells. Unlike antibiotics, β-1,3/1,6-glucan preparations are commercially available without restrictions on their application. The purpose of the present study was to evaluate the effect of β-1,3/1,6-glucan administered orally in the feed on the growth and survival of channel catfish fingerlings grown in cages. The glucan preparation used for this study was Agrastim®, and the basal ration was standard, commercially available, floating-pellet aquaculture feed. Two trials were conducted. In the first, 50 mg/kg and 100 mg/kg glucan dosages were compared to the basal ration and to the basal ration plus 1.2% agar top-coat used to facilitate application of glucan to the feed pellets. Treatments were isolated in separate ponds to prevent cross-contamination. The second trial compared the basal ration and 100 mg/kg glucan treatments in the same pond. At the dosages evaluated for this study, catfish survival

and growth were not improved over control treatments; however, beneficial effects of glucans have been reported at higher dosages and additional research is suggested.

DISEASES OF CAGE-REARED CATFISH. David Crosby[1] , Edward N. Sismour[2] & Scott H. Newton[2], [1]Virginia Cooperative Extension, Virginia State University, PO Box 9081, Petersburg VA 23806 and [2]Agriculture Research Station, PO Box 9061, Virginia State University, Petersburg VA 23806. Many producers of catfish in Virginia use farm ponds that are only suited for cage production. Catfish fingerlings are purchased from out-of-state producers and can spend over 20 hours in transit on a hauling truck. Transport time, crowding and associated factors may cause stress that potentially induces disease outbreaks. A study, initiated in 2007, is underway to assess and quantify factors contributing to catfish mortality following transport and cage stocking in the spring and the fall. Fish health assessments are conducted at the initial stocking and at 1, 2, and 3 weeks post stocking for which 60 fish are examined for diseases and external parasites on gills and skin. Not surprisingly, *Henneguya* sp was found at all initial stockings and during post stocking. Proliferative gill disease (PGD) was found at all initial spring stockings. However, fall stocking showed no clinical signs of PGD. Stocked catfish were infested with Ich within two weeks, except during fall 2008 when the catfish came down with Red Sore Disease. *Trichodina* sp and gill worms (*Ligictaluridus* sp.) were found in all spring initial stockings. The two fall stockings were free of most gill and skin parasites except for *Henneguya*. The 2007 spring stocking incurred 50% mortality attributed to Enteric Septicemia and columnaris. The 2007 fall stocking incurred only 1% mortality while the 2008 fall stocking had over 80% mortality. Fish stocked in the spring had more potential problems such as *Trichodina*, PGD and gill worms while fall fish had relatively few or any potential problems.

INSECTICIDAL ACTIVITIES OF *PARTHENUM ARGENTATUM* GRAY CRUDE METHANOLIC EXTRACT AND EXTRACT FRACTIONS ON ADULT GREENHOUSE WHITEFLY. F.D. Favi[1], M. Tellez[2], S.O. Duke[2] & M. Kraemer[1], [1]Virginia State University, Agricultural Research Service, PO Box 9061, Petersburg VA and & [2]University of Mississippi, USDA/ARS National Center of the Development of Natural Products, PO Box 8084, Stoneville MS. *P. argentatum* (guayule) is a perennial plant introduced into the US for production of latex for medical use as an alternative to latex from the hevea tree. Guayule latex is used for medical purposes because it does not induce reactions as does hevea's latex. Guayule resin content represents 10% of whole plant-extract and has pest control activities. Methanolic extract and its fractions were used to assess resin toxicity on adult greenhouse whitefly. Ethyl acetate fractions were coded A-C, methanolic fractions coded D-H and N-P while methylene chloride fractions were named I-M. Extracts were either used to coat vials or applied to tomato leaf disk to study contact or oral toxicities respectively. ANOVA (SAS statistic package, 2004) was used to analyze the results. Contact toxicity of fractions (D-H and N-P) were significant with $f = 4.78$ $df = 9$, $P < 0.001$. However, fractions coded H and P had killed adult whiteflies by contact within 3 hours and had been selected as the most toxic fractions of guayule methanol extract. Fractions J and L have significantly good oral toxicity at a very low dose ($f = 71.32$, $df = 4$, $p < 0.0001$).

ANAGEMENT OF A NATIVE BEE FOR POLLINATION OF VIRGINIA APPLE ORCHARDS. Mark E. Kraemer, Chelsea Johnson & Françoise Favi, Agricultural Research Station, Virginia State University, Petersburg VA 23806. The blue orchard bee (*Osmia lignaria* Say) is native to most of temperate North America and known to be an excellent pollinator of apple and other rosaceous tree fruits. However, management techniques need to be developed before this bee can be used in orchards. Initial research identified natural enemies and the life cycle phenology of this bee in Virginia. In the last two springs these bees were tested in 3 apple orchards in Virginia and North Carolina using artificial nesting sites. Adult bees established nests in sheltered areas near the orchards and were able to increase their numbers by up to 3X in one season. Parasitism was not a significant problem although pollen mites were present and could be a secondary problem if larval mortality is significant and large amounts of pollen are left for pollen mites. Pesticide sprays did not appear to affect nest building activity but larval mortality was high (20%) in one orchard and may have been correlated with early season fungicide applications. Large amounts of apple pollen, up to 98%, were found in some nest cells constructed during apple bloom.

ANALYSIS OF ESTS FOR DIFFERENTIAL GENE EXPRESSION TO ANTHRACNOSE IN YAM (*Diascorea alata* L). Satya S. Narina[1], Brian L. Sayre[1], Shaukat M Siddiqi[1], Alieu Sartie[2] & Robert Asiedu[2], [1]Department of Biology, PO Box 9064, Virginia State University, Petersburg VA 23806 and [2]International Institute of Tropical Agriculture (IITA), Oyo Road, PMB 5320 Ibadan, Nigeria. Molecular markers are ideal to investigate genetic effects on the resistance/susceptibility to disease. Simple Sequence Repeats (SSRs), repetitions of nucleotide motifs of 1-5 bases, are currently the markers of choice due to their abundant distribution in the genomes, and suitability for high-throughput analysis. Yam, (*Dioscorea alata* L), the main food source for over 100 million people in humid and sub-humid tropics, is vulnerable to anthracnose (*Colletotrichum gloeosporioides*) disease. This is one of the major limiting factors in the production of yam worldwide. A collaborative project between the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, Africa and Virginia State University, Petersburg, Virginia, USA was developed for genetic improvement and germplasm characterization of yams using molecular tools. Very limited sequence information is available from public genome databases. Total RNA was isolated from young leaves of resistant and susceptible genotypes and cDNA libraries corresponding to these two lines were constructed using Clontech's Creator SMART cDNA library construction kit. The libraries from the resistant and susceptible genotypes now have a total of 85,000 and 80,000 cDNA clones, respectively. These cDNA clones are currently being sequenced and nearly 80,000 EST sequences generated from this project are presented.